

1. Plasmatron-catalyst apparatus for generating hydrogen-rich gas comprising:
 - a plasmatron; and
 - at least one catalyst for receiving an output from the plasmatron to produce hydrogen-rich gas, wherein said at least one catalyst is located at a position downstream from the plasmatron so as to be activated by hydrogen and radicals produced by the plasmatron.
2. The apparatus of claim 1 wherein the plasmatron includes means for receiving as an input air, fuel and water/steam.
3. The apparatus of claim 2 wherein the plasmatron includes means for receiving exhaust gas from an engine or fuel cell.
4. The apparatus of claim 1 wherein the at least one catalyst includes means for receiving as an input air, fuel and water/steam.
5. The apparatus of claim 4 wherein the at least one catalyst includes means for receiving exhaust gas from an engine or fuel cell.
6. The apparatus of claim 2 wherein the at least one catalyst includes a heat exchanger in heat exchange relation with the catalyst to preheat the air, fuel and water/steam.
7. The apparatus of claim 1 including a plurality of catalyst sections, wherein each catalyst section receives additional air/fuel or water/steam.
8. The apparatus of claim 1 further including a fuel cell for receiving the hydrogen-rich gas, the hydrogen-rich gas having reduced CO content.
9. The apparatus of claim 8 wherein the plasmatron-catalyst apparatus is in a vehicle.

- 1 10. The apparatus of claim 8 wherein the plasmatron-catalytic system is stationary.
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- 3 11. The apparatus of claim 1 wherein the plasmatron is followed by a fuel injection system for a
- 4 partial oxidation process, the fuel injection system followed by said at least one catalyst, said
- 5 at least one catalyst followed by means for water/steam injection and a water-shifting catalyst
- 6 whereby hydrogen concentration is increased and CO concentration is decreased.
- 7
- 8 12. The apparatus of any of claims 1-11 wherein said at least one catalyst is selected from the
- 9 group consisting of a water-shifting catalyst, a partial oxidation catalyst and a steam
- 10 reforming catalyst.
- 11
- 12 13. The apparatus of claim 11 wherein said at least one catalyst is a combination of a partial
- 13 oxidation catalyst, a steam reforming catalyst and a water-shifting catalyst.
- 14
- 15 14. The apparatus of claim 13 wherein the steam reforming catalyst is followed by the water-
- 16 shifting catalyst with additional water/steam injection prior to the water-shifting catalyst.
- 17
- 18 15. The apparatus of claim 2 wherein the water/steam is obtained from oxidizing hydrogen in a
- 19 fuel cell or by combustion in an engine.
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- 21 16. The apparatus of claim 15 wherein said combustion in an engine includes combustion in a
- 22 diesel engine.
- 23
- 24 17. The apparatus of claim 2 wherein the water/steam is obtained from the exhaust from a diesel
- 25 engine.
- 26
- 27 18. The apparatus of claim 1 wherein the hydrogen-rich gas is used for reduction processes in
- 28 metallurgy and chemistry.
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19. The apparatus of claim 1 wherein the hydrogen-rich gas is used for hydrogenation as in food processing and fuel upgrading.

20. The apparatus of claim 1 further including a non-thermal catalytic reaction element to selectively oxidize CO to CO₂.

21. The apparatus of claim 11 wherein said at least one catalyst is a combination of a partial oxidation catalyst, a steam reforming catalyst, and a water-shifting catalyst, wherein water/steam is added between each of the catalysts.

22. The apparatus of claim 13 wherein the steam reforming catalyst is followed by the water-shifting catalyst without additional water/steam injection prior to the water-shifting catalyst.

23. The apparatus of claim 1 further including an engine wherein said hydrogen rich gas generated by said plasmatron-catalyst apparatus is delivered to said engine.

24. The apparatus of claim 1 wherein said position of the at least one catalyst is within 1 to 10 cm downstream from the plasmatron.

25. Plasmatron-catalyst apparatus for generating hydrogen-rich gas comprising:

a plasmatron; and

a catalytic converter containing at least one catalyst for receiving an output from the plasmatron to produce hydrogen-rich gas, wherein said at least one catalyst in said catalytic converter is located at a position downstream from the plasmatron and is activated by hydrogen and radicals produced in the output of the plasmatron.

26. The apparatus of claim 25 wherein said at least catalyst in said catalytic converter is further activated and/or preheated by the enthalpy of the output of the plasmatron.

- 1 27. The apparatus of claim 25 wherein said plasmatron-catalyst apparatus operates in
2 conjunction with an internal combustion engine.
3
- 4 28. The apparatus of claim 25 wherein the plasmatron-catalyst apparatus is in a vehicle.
5
- 6 29. The apparatus of claim 25 wherein said position of the at least one catalyst is within 1 to 10
7 cm downstream from the plasmatron.